

CLAIMS

1 1. An evaporator unit comprising:

2 A) a feed inlet into which an inlet flow of liquid can be introduced;

3 B) a heat exchanger including heat-transfer surfaces that form at least one

4 evaporation chamber into which liquid can be introduced to evaporate it;

5 C) a make-up-liquid guide that defines a make-up path along which it directs

6 liquid from the inlet to the at least one evaporation chamber;

7 D) a filter so interposed in the make-up path as to filter liquid that flows

8 therethrough;

9 E) a recirculation guide that defines a recirculation path along which it re-

10 turns to the at least one evaporation chamber liquid that has passed

11 through the at least one evaporation chamber without evaporating; and

12 F) a transfer valve interposed in the recirculation path and operable between:

13 i) a recirculation state, in which it permits liquid that has passed

14 through the at least one evaporation chamber without evaporating

15 to return along the recirculation path to the at least one evaporation

16 chamber; and

17 ii) a flush state, in which it diverts liquid from the recirculation path

18 into the filter.

1 2. An evaporator unit as defined in claim 1 further including:

2 A) a refresh-liquid reservoir;

3 B) a feed-liquid-storage guide that defines a feed-liquid-storage path along

4 which it directs liquid from the feed inlet into the refresh-liquid reservoir

5 while the transfer valve is in its recirculation state; and

6 C) a refresh guide that defines a refresh path along which it directs liquid

7 from the refresh-liquid reservoir to the at least one evaporation chamber

8 while the transfer valve is in its flush state.

1 3. An evaporator unit as defined in claim 1, further including:
2 A) a concentrate reservoir; and
3 B) a concentrate-storage guide defining a concentrate-storage path along
4 which it directs liquid from the liquid collector through the filter into the
5 concentrate reservoir when the transfer valve is in its flush state.

1 4. An evaporator unit as defined in claim 3 further including:
2 A) a refresh-liquid reservoir;
3 B) a feed-liquid-storage guide that defines a feed-liquid-storage path along
4 which it directs liquid from the feed inlet into the refresh-liquid reservoir
5 while the transfer valve is in its recirculation state; and
6 C) a refresh guide that defines a refresh path along which it directs liquid
7 from the refresh-liquid reservoir to the at least one evaporation chamber
8 while the transfer valve is in its flush state.

1 5. An evaporator unit as defined in claim 4, further including:
2 A) a piston chamber; and
3 B) a piston so movably disposed in the piston chamber as to divide it into the
4 refresh-liquid and concentrate reservoirs.

1 6. An evaporator unit as defined in claim 5, further including a valve operator that so
2 operates the transfer valve as alternately to define flush cycles, in which the transfer
3 valve is in its flush state, and recirculation cycles, in which the transfer valve is in its re-
4 circulation state.

1 7. An evaporator unit as defined in claim 6 wherein the average duration of the re-
2 circulation cycles is at least fifty times that of the flush cycles.

1 8. An evaporator unit as defined in claim 6 wherein the valve operator includes the
2 piston, whose position determines the state of the transfer valve.

1 9. An evaporator unit as defined in claim 8 wherein the average duration of the re-
2 circulation cycles is at least fifty times that of the flush cycles.

1 10. An evaporator unit as defined in claim 4 wherein the flow of liquid into the con-
2 centrate reservoir while the transfer valve is in its flush state so drives the piston as to re-
3 duce the size of the refresh-liquid reservoir and thereby drive liquid therefrom through
4 the refresh path.

1 11. An evaporator unit as defined in claim 4 further including:
2 A) a concentrate outlet; and
3 B) a concentrate-discharge guide defining a concentrate-discharge path along
4 which it directs liquid from the concentrate reservoir to the concentrate
5 outlet while the transfer valve is in its recirculation state.

1 12. An evaporator unit as defined in claim 11 wherein the flow of liquid into the con-
2 centrate reservoir while the transfer valve is in its flush state so drives the piston as to re-
3 duce the size of the refresh-liquid reservoir and thereby drive liquid therefrom through
4 the refresh path.

1 13. An evaporator unit as defined in claim 1 wherein the heat-transfer surfaces addi-
2 tionally form at least one condensation chamber from which they can conduct heat to the
3 at least one evaporation chamber.

1 14. An evaporator unit as defined in claim 13 further including a vapor guide that di-
2 rect along a vapor path from the at least one evaporation chamber to the at least one
3 condensation chamber vapor produced in the evaporation chamber.

1 15. An evaporator unit as defined in claim 14 further including a compressor disposed
2 in the vapor path and operable to make the vapor pressure in the at least one condensation
3 chamber greater than that in the at least one evaporation chamber.

1 16. An evaporator unit as defined in claim 1, further including a valve operator that so
2 operates the transfer valve as alternately to define flush cycles, in which the transfer
3 valve is in its flush state, and recirculation cycles, in which the transfer valve is in its re-
4 circulation state.

1 17. An evaporator unit as defined in claim 16 wherein the average duration of the re-
2 circulation cycles is at least fifty times that of the flush cycles.

1 18. For evaporating liquid, a method comprising:

- 2 A) providing an evaporator unit that includes:
 - 3 i) a feed inlet into which an inlet flow of liquid can be introduced;
 - 4 ii) a heat exchanger including heat-transfer surfaces that form at least
 - 5 one evaporation chamber into which liquid can be introduced to
 - 6 evaporate it;
 - 7 iii) a make-up-liquid guide that defines a make-up path along which it
 - 8 directs liquid from the inlet to the at least one evaporation cham-
9 ber;
 - 10 iv) a filter so interposed in the make-up path as to filter liquid that
 - 11 flows therethrough;
- 12 B) introducing an inlet flow of liquid into the feed inlet;
- 13 C) during relatively long, recirculation cycles, returning to the at least one
- 14 evaporation chamber liquid that has passed therethrough without evapo-
15 rating; and
- 16 D) during relatively short, flush cycles, flushing the filter by directing there-
17 into liquid that has passed through the evaporation chamber without
- 18 evaporating.

1 19. A method as defined in claim 18 wherein the average duration of the recirculation
2 cycles is at least fifty times that of the flush cycles.

1 20. A method as defined in claim 18 wherein the heat-transfer surfaces additionally
2 form at least one condensation chamber from which they can conduct heat to the at least
3 one evaporation chamber.

1 21. A method as defined in claim 20 wherein the method includes directing along a
2 vapor path from the at least one evaporation chamber to the at least one condensation
3 chamber vapor produced in the evaporation chamber.

1 22. A method as defined in claim 21 wherein the method includes so compressing
2 vapor in the vapor path as to make the vapor pressure in the at least one condensation
3 chamber greater than that in the at least one evaporation chamber.

1 23. A method as defined in claim 21 wherein the average duration of the recirculation
2 cycles is at least fifty times that of the flush cycles.

1 24. An apparatus for evaporating liquid comprising:
2 A) a feed inlet into which an inlet flow of liquid can be introduced;
3 B) a heat exchanger including heat-transfer surfaces that form at least one
4 evaporation chamber into which liquid can be introduced to evaporate it;
5 C) a filter;
6 D) means for directing liquid from the inlet along a make-up path through the
7 filter to the at least one evaporation chamber;
8 E) means for, during relatively long, recirculation cycles, returning to the at
9 least one evaporation chamber liquid that has passed therethrough without
10 evaporating; and
11 F) means for, during relatively short, flush cycles, flushing the filter by di-
12 recting thereinto liquid that has passed through the evaporation chamber
13 without evaporating.

1 25. An apparatus as defined in claim 24 wherein the average duration of the recircu-
2 lation cycles is at least fifty times that of the flush cycles.

- 1 26. An apparatus as defined in claim 24 wherein the heat-transfer surfaces addition-
- 2 ally form at least one condensation chamber from which they can conduct heat to the at
- 3 least one evaporation chamber.

- 1 27. An apparatus as defined in claim 26 further including means for directing along a
- 2 vapor path from the at least one evaporation chamber to the at least one condensation
- 3 chamber vapor produced in the evaporation chamber.

- 1 28. An apparatus as defined in claim 27 further including means for so compressing
- 2 vapor in the vapor path as to make the vapor pressure in the at least one condensation
- 3 chamber greater than that in the at least one evaporation chamber.

- 1 29. An apparatus as defined in claim 27 wherein the average duration of the recircu-
- 2 lation cycles is at least fifty times that of the flush cycles.